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Nest-building Behavior and Food Habits of The Rice Rat, Oryzomys palustris natator, From Merritt Island, Brevard County, Florida

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TABLE OF CONTENTS

Acknowledgement	iii
Table of Contents	iv
Introduction	1
History and Taxonomic Review	1
Natural History	3
Statement of Problem and Objectives	5
Materials and Methods	7
Description of Habitats and Capture Localities	7
Field Techniques	8
Laboratory Techniques	9
Statistical Techniques	11
Results	12
Standard Measurements	12
Nest-Building Analysis	12
Food Habits Analysis	13
Discussion	15
Summary	21
Appendix	23
References Cited	40

INTRODUCTION

History and Taxonomic Review

Oryzomys palustris was first described by R. Harlan (1837) as *Mus palustris*. The holotype was from the fresh-water swamps at "Fast Land" near Salem, New Jersey, but for decades thereafter there was considerable controversy regarding the type locality. Harlan evidently used a study skin from New Jersey and a skull from South Carolina to describe the genus. He apparently found the incorrectly classified New Jersey skin in the collection of the Academy of Natural Sciences of Philadelphia after he had received a skin and skull which J. Bachman had taken in St. John's Parish, South Carolina, in 1816. The controversy existed (1837-1902) due to the lack of other specimens from New Jersey until Rhoads (1902) obtained a series of *Oryzomys* from Cumberland County, New Jersey, which fixed the type locality.

In 1854, Bachman described *Oryzomys palustris* under the name *Arvicola oryzivora*, the rice-meadow-mouse. He obtained specimens from the rice fields of South Carolina; from the salt marshes near Charleston, South Carolina, and near Savannah, Georgia; and from the Everglades of Florida.

Baird (1859) recognized that rice rats belonged to the New World rodents (Cricetidae). He grouped them with *Peromyscus* in the genus *Hesperomys*, even though he recognized enough variation in skull characters to assign rice rats to the subgenus *Oryzomys*, species

palustris. Goldman (1918) stated that in 1890 Elliott Coues raised the name Oryzomys to full generic rank.

In 1889, F. Chapman recorded an unnamed species in his letters from Florida (Austin, 1967). This species must surely have been Oryzomys palustris, for soon thereafter he described a new subspecies, Oryzomys palustris natator, from Gainesville, Alachua County, Florida (Chapman, 1893). Merriam (1901) first reviewed the genus and the most recent review was that of Goldman (1918).

Distribution

Rice rats range from New Jersey and southern Illinois, southward into Mexico, Central America, and into South America, where the genus finds its greatest diversity. One species is found on the Galapagos Islands (Walker, 1964). As shown in Figure 1, there are five subspecies in Florida: O. p. palustris Harlan, from the panhandle east to Burnside Beach; O. p. natator Chapman, from Anastasia Island throughout Central Florida to just north of Lake Okeechobee; O. p. planirostris Hamilton, from Pine Island and the adjacent mainland north of Fort Myers; O. p. sanibeli Hamilton, from Sanibel Island; and O. p. coloratus Bangs, from Eden southward throughout the Everglades (Hall and Kelson, 1959).

The first record of O. p. natator is that of Chapman when he described the subspecies in 1893. Bangs (1899) trapped them on Anastasia Island and at Carterville, St. John's County; at Gainesville, Alachua County; at Enterprise, Volusia County; at Oak Lodge, Brevard County; and at Crystal River, Citrus County. Elliot (1901) recorded a number trapped by Thaddeus Surber at Enterprise, Volusia County; at Micco, Brevard County; and at Gainesville, Alachua County. In addition

to the above localities, Goldman (1918) recorded specimens from Fort Kissimmee, Highlands County; Lake Kissimmee and Kissimmee, Osceola County; Geneva, Lake Harney, and Mullet Lake, Seminole County; Ocala, Marion County; Tarpon Springs, Pinellas County; and Titusville, Brevard County. Fargo (1928) found O. p. natator to be the only mammal on Tarpon Key, Pinellas County. Rand and Host (1942) trapped O. p. natator in Highlands County. Pournelle and Barrington (1953) trapped O. p. natator in a salt marsh and on the edge of a seepage pool on Anastasia Island, St. John's County. Pournelle (1950) and Birkenholtz (1963) both recorded movements of rice rats near Gainesville, Alachua County; and Worth (1950) reported his observations on behavior and breeding of captive individuals from Hillsborough County. Dewsbury (1970a, 1970b) observed food hoarding and copulatory behavior of O. p. natator that he trapped on Payne's Prairie near Gainesville, Alachua County.

Natural History

Rice rats typically inhabit wet, marshy areas but are often trapped in dry areas such as old fields bordering these marshes (Bangs, 1898; Hamilton, 1946; Worth, 1950; Negus et al., 1961; and Birkenholtz, 1963). Bachman (1854) noted that O. palustris swims and dives readily. Oryzomys palustris occurs sympatrically with the muskrat (Ondatra zibethica) and the round-tailed muskrat (Neofiber alleni). It is possible that some of the previously published data concerning food habits of O. palustris have been obtained from scats and food scraps of Ondatra and Neofiber.

O. palustris is reported to build nests in burrows made in ditch

banks (Bachman, 1854; Elliot, 1901; Goldman, 1918; and Svihla, 1931) and above the high water mark in grass (Bachman, 1854; Sharp, 1967) and in tree bases (Fargo, 1929; Hamilton, 1946).

Rice rats apparently breed year round. Females exhibit postpartum estrus and the gestation period is approximately 25 days (Goldman, 1918; Svihla, 1931; Hamilton, 1946; Worth, 1950; Harris, 1953; and Negus et al., 1961).

Except for the above points, reports on habits of O. palustris seem contradictory. As early as 1854, Bachman noted the tendency of rice rats to eat meat. In his revision of the genus, Goldman (1918) said that they feed extensively on green or succulent plants, which form the normal diet in most Oryzomys species, but that seeds and meat are eaten at times. Svihla (1931), Rhoads (1902), Hamilton (1946, 1955), and Pournelle (1950) indicated that rice rats prefer plant material in the wild. Rand and Host (1942) and Negus et al. (1961) described O. palustris as omnivorous. Sharp (1967), however, concluded that rice rats were preferentially carnivorous in the summer, although he said that plant foods may be utilized at other times of the year. Kale (1965) reported predation of rice rats on the Long-billed Marsh Wren (Telmatodytes palustris) and Schantz (1943) reported O. palustris feeding on trapped muskrats.

Worth (1950) noted that in captivity male and female rice rats do not share a nest, while Negus et al. (1961) reported communal nests in winter.

In his description of rice rats, Hamilton (1946) stated that they are easily trapped and docile in behavior. Others (Erickson, 1949;

Pournelle and Barrington, 1952; Harris, 1953; Negus et al., 1961; and Birkenholtz, 1963) indicate less than 2% trap success and describe rice rats as never easily tamed.

Rice rats are generally considered to be nocturnal; however, Hamilton (1946) recorded diurnal captures of rice rats whose stomach contents indicated recent feeding, and Bachman (1854) recorded daylight sightings on ditch banks.

Statement of Problem and Objectives

The purpose of this study was to characterize nest-building behavior of Oryzomys palustris natator in the laboratory, and to determine the effects of temperature and season on nest construction.

Extensive literature exists regarding rodent behavior and ecology. However, the majority of cricetid behavioral studies have involved the widespread genus Peromyscus. These studies suggested methods for my study and provided a comparison for Oryzomys behavior. Most of these studies used animals that were laboratory-reared for as many as 20 generations (e.g. Harris, 1953; Dice and Clark, 1962; and King et al., 1964). Behavioral differences between laboratory-reared and field-caught individuals have been reported by Wecker (1964), Layne (1969,1970), Price (1970), and Ehrhart (1971).

Sealander (1952) found better nest-building response in winter-caught Peromyscus leucopus noveboracensis than in summer-caught individuals. Thorne (1950) reported that temperatures of 33°C virtually eliminated nest building, whereas, temperatures of 8°C increased the nest-building activities of P. maniculatus osgoodi. King et al. (1964) described a cline in thermoregulatory behavior in three species of

Peromyscus where northern forms used more nesting material under constant conditions than did southern forms. Layne (1969) and Wolfe (1970) concluded that evolution of nest-building behavior in Peromyscus is influenced more by microhabitat, which includes such ecological factors as habitat and nest site preference, than by climatic differences. Jaslove and McManus (1972) found Peromyscus nests to be 100% larger at 20°C than at 30°C. They also reported no significant increase in nest size at temperatures lower than 20°C and suggested that insulative advantages of larger nests at lower temperatures may be outweighed by the energy cost of construction. King et al. (1964), Layne (1969), and Wolfe (1970) reported no sexual differences in nest-building behavior in Peromyscus. Jaslove and McManus (1972), however, discovered significant sex differences with females building larger nests at all temperatures.

In light of the conflicting reports concerning food habits of O. palustris, a further objective of this study was to determine the food habits of the Merritt Island population.

A secondary objective was to characterize the Merritt Island population in terms of standard measurements in order to compare it with other populations of O. p. natator. Chapman (1893) described the central Florida rice rat as larger and darker than O. p. palustris. In his review of the genus, Merriam (1901) remarked that O. p. natator from Cape Canaveral, Brevard County, is the same color but is decidedly smaller than other populations of the subspecies. Merriam (1901) also stated that the Cape Canaveral population had a skull type intermediate between those of O. p. palustris and O. p. natator.

MATERIALS AND METHODS

Description of Habitats and Capture Localities

Oryzomys palustris inhabits brackish, fresh-water, and salt-water marshes. The animals used in this study were taken in several similar habitats on Merritt Island National Wildlife Refuge, Brevard County, Florida (Figure 2). Prior to 1957, much of Merritt Island was covered with large salt marshes. At that time, as part of a mosquito control program, earth dikes were constructed to maintain a constant water level. Therefore, today, many of the former salt marshes have freshened except during periods of drought when salt-water intrusion occurs.

Rice rats were taken at six localities on the Refuge, four of which (Figure 2: localities 1,2,3,6) are permanent study areas established for "A Study of a Diverse Coastal Ecosystem on the Atlantic Coast of Florida", a project funded by the National Aeronautics and Space Administration, and being carried out by the Department of Biological Sciences, Florida Technological University. The capture localities are listed below and are indicated in Figure 2. Dominant plants in each area are also given.

1. Sec. 19, R 37 E, T 21 S; and Secs. 13 and 24, R 36 E, T 21 S. ca. 0.3 km NW of State Road 402, near the SW shore of Mosquito Lagoon. *Paspalum* spp., *Distichlis spicata* (L) Greene, *Sesuvium* spp., *Amaranthus cannabinus* (L) Sauer.

2. Sec. 21, R 36 E, T 21 S. ca. 1.6 km WNW of the intersection of State Roads 3 and 402 (Wilson's Corner). *Spartina bakerii* Merrill, *Cladium jamaicensis* Crantz.

3. Sec. 7, R 37 E, T 21 S. ca. 0.4 km E of State Road 3, at Banana Creek. Distichlis spicata (L) Greene, Sesuvium spp.

4. Sec. 33, R 36 E, T 20 S. ca. 0.4 km W of State Road 402, SE perimeter of Dummitt Cove. Avicinnia germinans spp., Sabal palmetto (Walt.) Lodd ex Schultes.

5. Sec. 36, R 36 E, T 21 S. ca. 1.3 km NE of intersection of State Road 3 and Happy Creek Road. Panicum spp., Cladium jamaicensis Crantz, Andropogon spp.

6. Sec. 27, R 36 E, T 21 S. ca. 1.3 km SE of intersection of State Road 402 and Wisconsin Village Road. Spartina bakerii Merrill.

Field Techniques

Animals used for the nest-building experiments were captured in Sherman live traps set in suitable habitat. Trapping continued until four adult males were captured. At the end of a testing period, the animals were marked by toe-clipping and with ear tags, and were released at the point of capture. Sealander (1952), Thorne (1958), Layne (1969), Wolfe (1970), and Jaslove and McManus (1972) all used field-caught Peromyscus for their nest-building studies; however, in most cases, the animals had been held in laboratory colonies for several months or more prior to testing. In the current study, no animal was used more than once to eliminate possible learning effects. A total of 12 rice rats from localities 1 and 6 (Figure 2) was tested. I used adult males to eliminate behavioral effects resulting from the female estrous cycle (Kinder, 1927; Layne, 1969, 1970) and to provide for similar prior natural nest-building experience.

More rice rats were required for the food habits studies. Each trap was prebaited for at least two days before trapping because Oryzomys avoids traps for some time. The traps were checked several

times throughout the night so that each animal could be sacrificed as soon after capture as possible. Each animal was injected intraperitoneally with 0.2 cc Sleepaway (active ingredient: sodium pentobarbital) and was frozen as soon as possible for later analysis.

Specimens were obtained from localities 2 and 4 (Figure 2) as part of a separate, ongoing population study. During the study, several animals knocked traps into the water and drowned, thus providing specimens from these locales. In locality 1 (Figure 2), Sherman live traps were set in two lines: a 1 km line along the road and a second line that could be checked from a canoe. A total of 34 animals was captured in 959 trap nights (3.5% trap success). In locality 3, Sherman live traps were set and marked with flagging. Two animals were caught in 15 trap nights yielding 13.3% success. Traps were set in a crescent-shaped line in locality 5. These 168 trap nights produced two captures (1.2% success). Traps were set in locality 4 for 25 trap nights; no animals were captured. The total number of trap nights was 1167. The overall capture rate was 5.4%.

Laboratory Techniques

In the nest-building studies, each adult male O. p. natator was housed in a gray, 30 cm x 50 cm wooden box. Each box was provided with vermiculite as litter and 1.25 cm mesh hardware cloth as a cover. Water and commercial dog chow were provided ad libitum. To each box I attached a 0.45 kg metal cylinder into which was coiled ca. 80 g of cotton. The free end of the cotton was inserted into a 2 cm hole in the box wall. I placed four such boxes together in a Seher Controlled Environment Chamber with a 12/12 light/dark photoperiod. The rats were

left for one day of acclimation at 22°C and I removed and discarded any nest that had been built that day. On each of the next four mornings I removed the cotton that remained in each cylinder and weighed the cotton to determine the amount each rat had pulled for the nest. I subtracted the weight of any cotton that had been pulled but not actually incorporated into the nest. I lowered the ambient temperature to 16°C and for four consecutive nights I measured nests. After one night of reacclimation at 22°C, the rats were subjected to an ambient temperature of 33°C for four nights. I chose the above ambient temperatures because 16°C is the January mean temperature, 33°C is the July mean temperature, and 22°C is both the January mean maximum temperature and the July mean minimum temperature at the United States Weather Bureau Station nearest to the trapping localities. I used animals trapped in June, September, and January so that any seasonal variation in nest size could be determined. The nest-building experiments provided data for 144 test nights. The subjective nest-type index was based on the following characteristics:

0--no nest

1--platform nest--simple flat pad without sides

2--cup nest--sides present, but not roofed over

3--hollow nest of two sides and a roof, but utilizing the box sides as two sides of the nest

4--hollow, spherical nest with roof, but with one side being the side of the box

5--hollow, spherical nest completely roofed over.

After thawing the sacrificed specimens, I took standard measurements, noted reproductive condition, and preserved the stomachs

and embryos in 10% Formalin. Forty-two specimens, prepared as museum study skins, are deposited in the mammal collection of Florida Technological University. I measured and examined the stomach contents using the techniques described by Korschgen (1971). I also prepared slides of samples of the stomach contents for examination under the compound microscope.

Statistical Techniques

I subjected the nest size data to a 3 x 12 analysis of variance with four repeated measures, using the University of North Carolina Psychometric Laboratory Computer Program. I further tested for the homogeneity of variances using the Statistical Package for the Social Sciences (SPSSH) which employs the Student-Neuman-Keuls modification of the Q test. The nest type data were examined using analysis of variance and the difference between pairs of means was tested using the Student-Neuman-Keuls Q test as described by Snedecor and Cochran (1967).

The standard measurements were compared by t-tests (Snedecor and Cochran, 1967).

RESULTS

Standard Measurements

Aging techniques for *Oryzomys* are not available. Negus *et al.* (1961) concluded, however, that total length was a more accurate indication of adult status than was weight. A female 220 mm in total length weighing 49.8 g had two small embryos in each uterine horn. A non-pregnant female 230 mm in total length weighed 48.0 g; I set the minimum criteria for adult females at a total length of 220 mm and a weight of 48.0 g. A rice rat measuring 239 mm and weighing 53.5 g had larger testes than did an adult male. Therefore, I set the minimum criteria for adulthood in males at a total length of 239 mm and a weight of 53.5 g.

The mean weight of adult *O. p. natator* males (86.9 g) is significantly ($P<0.05$) greater than that of adult females (60.8 g). The mean total length of adult *O. p. natator* males (272.2 mm) is also significantly ($P<0.05$) greater than that of adult females (247.5 mm). Table 1 summarizes the standard measurements.

Nest-Building Analysis

The analysis of variance indicated that there were significant differences among nest sizes at varying ambient temperatures ($P=0.024$) and among individual subjects ($P=0.002$); however, there was no significant interaction ($P=0.545$) between any one temperature and any one subject.

Figure 3 shows that when the nest weights of rice rats captured in all three seasons are combined, the mean nest weight decreases with an increase in temperature. Further testing for the homogeneity of variances reveals that the nest size at 33°C differs significantly from that at 16°C ($P<0.05$). However, nests built at 22°C do not differ significantly from those at either 16°C or 33°C ($P<0.05$).

Figure 4 indicates differences in mean nest weight (all temperatures combined) between animals caught in June, September, and January. Nest size of those animals trapped and tested in June and those trapped and tested in September differs significantly ($P<0.05$); however, those trapped and tested in January built nests that do not differ significantly from either of the other two groups ($P<0.05$).

Figure 5 shows the mean weight of nests built at each ambient temperature by animals captured in each season. The only temperature at which no nest was built was 33°C. This occurred with rice rats captured in all three seasons. The Student-Neuman-Keuls test shows no significant difference ($P<0.05$) in nest size among the means of the subgroups indicated by the columns.

Figure 6 indicates percentage distribution of nest types. Analysis of variance revealed there were some significant differences ($P<0.05$) among nest-type means at the various temperatures. When the data are combined by test temperatures, Q tests showed a significant difference ($P<0.05$) between the nest-type indexes for nests built at 16°C and those built at 33°C, and between those built at 22°C and 33°C.

Food Habits Analysis

Mean volume of the stomach contents of forty-two adult Merritt

Island rice rats was 2.3 ml (range: 0.1--7.0). The contents were largely unidentifiable animal parts. The following is a list of those taxa that I could identify using Pennak (1953): Pristina spp. (Annelida:Naididae), Tendipes spp. (Arthropoda:Tendipedidae) larvae and pupae, Palaemonetes spp. (Arthropoda:Palaemonidae), and two types of Nematodes. In addition, there were numerous insect legs, wings, bits of exoskeleton, and setae; crustacean exoskeleton (probably the prawn, Palaemonetes, and/or the crayfish, Procambarus (Arthropoda:Astacidae), which were collected in the habitat). From trap stations, I collected shells which appeared to be rodent-opened because of the teeth marks on them. The shells were from the snails Physa spp. (Mollusca:Neritidae), Polygyra spp. (Mollusca:Polygyridae), and Euglandina spp. (Mollusca: Oleacinidae); and from the clam, Modiolus demissus (Mollusca:Mytilidae). One stomach contained bird flesh approximately 1 cm x 2 cm with skin and feathers attached, and several other stomachs contained feathers. Plant tissue was present in small quantities. I found no seeds or seed coats.

Although an examination of Oryzomys activity patterns was not a major objective of this study, some data were obtained because of the necessity of trapping localities 1, 3, and 5 throughout the night. Between 1900 and 2300 hours 51.5% of the rice rats were captured, 27% were captured between 2301 and 0300 hours, none were captured between 0301 and 0700 hours, and 21% were captured between 0701 and 1000 hours.

DISCUSSION

Analysis of the standard measurements of Merritt Island Oryzomys indicates a degree of sexual dimorphism. Nevertheless, I grouped the measurements of males and females for purposes of comparing the Merritt Island population with the 10 paratopotypes (from Gainesville, Alachua County) that Goldman (1918) measured (Table 2). Oryzomys palustris natator specimens from Merritt Island are significantly ($P<0.05$) smaller than those from Gainesville in terms of total length and hind foot length. However, the two populations do not differ significantly ($P<0.05$) in terms of tail length.

Merriam (1901) remarked that specimens of O. p. natator from Cape Canaveral, Brevard County, were decidedly smaller than other O. p. natator, but he did not record data. He reported mean measurements of six males from Lake Kissimmee, Osceola County, as: total length, 295 mm; tail vertebrae, 151 mm; and hind foot, 35 mm, but he recorded no measurement ranges. Since Merriam's specimens are larger than those measured by Goldman (1918) (Table 2), my data appear to confirm Merriam's observations regarding relative size of rice rats from the Cape Canaveral-Merritt Island region.

Analysis of the nest-building experiments indicates a reasonably clear trend in the responses of rice rats to varying ambient temperatures. The results derived from the two measures of response are in basic agreement. As measured both by nest-type index and by nest

size (Figures 3 and 6), the response of O. p. natator to an ambient temperature of 33°C is significantly lower ($P<0.05$) than the response at 16°C. The pattern is also seen in the comparison of the nest-building response at 33°C and 22°C. Here, too, the nest-type index is significantly lower ($P<0.05$) at the higher temperature. Mean nest weight is also markedly smaller at 33°C than at 22°C, but the significance of the difference between the two means does not quite reach the 5% level. Nevertheless, the disparity of the means of nest sizes fits well into the overall pattern and it is reasonable to expect that this difference would also attain the 5% level with somwhat larger sample sizes.

Thus, it seems apparent that the nest-building response of O. p. natator is similar to that of Peromyscus, the only other cricetine rodent that has been studied. Thorne (1958) reported that high temperature (33°C) reduced and low temperature (8°C) increased the nest-building response of P. maniculatus osgoodi. Lynch (1974) found that P. leucopus used more cotton at 5°C than at 26°C regardless of prior temperature acclimation or photoperiod. Jaslove and McManus (1972) found that June-captured P. leucopus constructed the smallest nests at high temperatures, the largest nests at 20°C, and approximately the same size nests with decreasing ambient temperature.

No pattern is evident when nest-building data are grouped by seasons (Figures 4 and 5). Sealander (1952) concluded that at -30°C summer-captured P. leucopus and P. maniculatus exhibited a poorer nest-building response than winter-captured subjects. O. p. natator does not fit this pattern. The lack of interseasonal variation in

nest-building response of the central Florida rice rat may be related to the distribution and habitat preference of the species. O. p. natator inhabits warm, humid marshes and has a noticeably denser pelage than other Florida cricetines. Therefore, it seems likely that central Florida rice rats need a well built nest for protection from cold in winter and from heat in summer.

King et al. (1964) discussed the thermoregulatory nature of nests. Layne (1969) and Wolfe (1970) refined the idea to include the influence of microhabitat on nest size. Wolfe (1970) reported that Peromyscus gossypinus from Santa Rosa County, Florida, built nests that weighed approximately 50% of mean body weight. He also stated that P. polionotus collected from Santa Rosa Island, Escambia County, Florida, built nests that weighed approximately 34% of mean body weight. Mean nest weight (40 g) in the nest-building experiments reported here is approximately 50% of the mean body weight (79.5 g) of the rice rats. Peromyscus polionotus nests in burrows, P. gossypinus generally nests above ground in woodlands, and O. palustris nests in open, grassy marshes. It is possible that a large nest located above ground level would be selectively advantageous as a means of protection from daily temperature and weather fluctuations. Burrow-nesters would not be subjected to such fluctuations and would not need the same amount of protection.

From the data presented in Figure 7, it seems apparent that the bulk of O. palustris feeding occurs just after dark and around dawn, when 72.5% of the animals were captured for the food habits study. Rice rats are strongly nocturnal as indicated by the fact that rats

rarely, if ever, appear in traps during daylight checks. However, in captivity, rice rats will occasionally leave the nest during the day.

In the environmental chamber, rice rats would not build nests in total darkness. When I fastened the observation door of the chamber open and thus admitted a small amount of light during the dark part of the cycle, the rice rats constructed nests. Thorne (1958) reported that light reduced the quality of nest building of P. m. osgoodi except at very low temperatures. Kavanau (1967) found that when allowed to control ambient illumination, Peromyscus selected conditions of reduced light in preference to total darkness during activity periods. It appears that O. p. natator shares this tendency.

Although the majority of the stomachs examined did contain a small amount of plant material, it was never in sufficient quantity to be considered as a major food source. According to the criteria of Hamilton (1946), the two juvenile O. p. natator were not completely weaned at weights of 15 g and 15.9 g. However, the stomach of one contained a seta and the stomach of the other contained several pieces of exoskeleton. Stomachs of two specimens captured along the Oklawaha River, Marion County, which I examined for comparison, also showed little plant material.

Three stomachs contained feathers and bird flesh. Schantz (1943) reported that rice rats fed on trapped muskrats. Hamilton (1946) recorded that O. palustris fed on skinned Peromyscus and sparrows which he gave to them. Kale (1965) reported O. palustris to be a significant predator on Long-billed Marsh Wren eggs and nestlings where the two species coexist. He found only one incident of a rice rat taking an

adult wren; the bird was incubating. However, the marsh birds common to the capture localities in the present study do not breed there in February (Sprunt, 1954) when my specimens were taken. Therefore, it seems unlikely that the feathers in the rice rats' stomachs could have come from eggs or nestlings. The area in which O. p. natator were trapped had been open for duck hunting until 19 days prior to the capture of the first rice rat that had fed on avian material. It seems probable that these O. p. natator had fed on birds that died subsequent to hunting season. Apparently, rice rats are predaceous or necrophagous as opportunities arise.

My observations indicate that O. p. natator is primarily carnivorous during the winter, when most of my food study specimens were captured. The few non-winter caught specimens that I examined were also primarily carnivorous. These results, together with the results of Sharp (1967), suggest that O. palustris, unlike most of its cricetid relatives, is strongly carnivorous throughout the year.

Harris (1953) reported that, in the northern part of its range, O. palustris frequently utilizes muskrat (Ondatra zibethica) feeding platforms and nests. Approximately 40% of his rice rat captures were made at stations showing no small mammal sign. In Florida, O. palustris shares habitats with the round-tailed muskrat (Neofiber alleni). Rice rats leave little or no sign in the wild; on the other hand, Neofiber leaves scats and cuttings throughout its habitat. Neofiber has never been proven to be carnivorous, although this has been suggested because of crustacean exoskeleton and mollusk shells that have been found on their feeding platforms. It is quite possible that scraps of animal

foods of O. palustris have been mistaken for those of Neofiber and that plant remains attributed to O. palustris have been those left by Neofiber. A definitive answer to this awaits a thorough analysis of the food habits of Neofiber.

SUMMARY

Studies of nest-building behavior and food habits of the central Florida rice rat, Oryzomys palustris natator, were carried out using specimens taken primarily from the Merritt Island National Wildlife Refuge, Brevard County, Florida. All specimens sacrificed for the food habits analysis were prepared as museum study skins which are housed in the mammal collection of Florida Technological University, Orlando, Florida.

A brief analysis of the standard measurements obtained revealed that those O. p. natator from Merritt Island are significantly ($P<0.05$) smaller than those from Gainesville, Alachua County, measured by Goldman (1918).

Subjects used for the nest-building studies were captured just prior to testing and released at the point of capture after testing was completed. Data analyses indicate a reasonably clear trend in the responses of rice rats to varying ambient temperatures. As measured by both nest-type index and by nest size, O. p. natator, like its cricetid relative Peromyscus, builds smaller nests at high temperatures and increasingly larger nests at lower temperatures. Unlike Peromyscus, the central Florida rice rat shows little interseasonal variation in nest-building response. This is probably due to the need for winter cold-protection and, considering the density of the pelage, summer heat-protection for such a semiaquatic, subtropical animal.

Examination of 42 stomachs, when compared with existing data, reveals that Oryzomys palustris is primarily carnivorous in winter and probably throughout the year.

APPENDIX

Figure 1. Distribution of the five Florida subspecies of Oryzomys palustris. (Hall and Kelson, 1959)

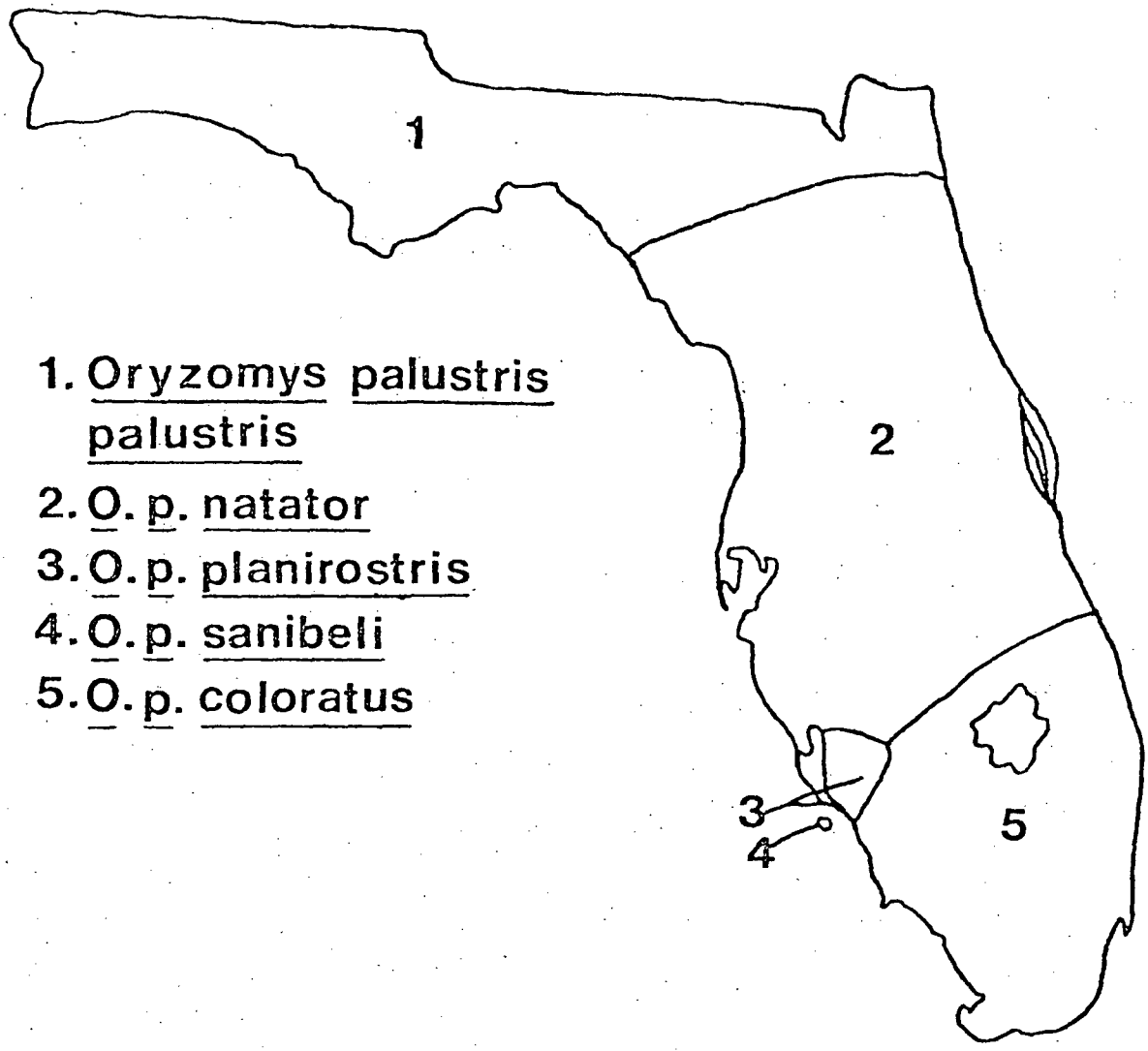
1
2
3
4
5
1. Oryzomys palustris palustris
2. O. p. natator
3. O. p. planirostris
4. O. p. sanibeli
5. O. p. coloratus

Figure 1

Figure 2. Capture localities of O. p. natator on Merritt Island, Brevard County, Florida. See text for explanation of the numbered sites.

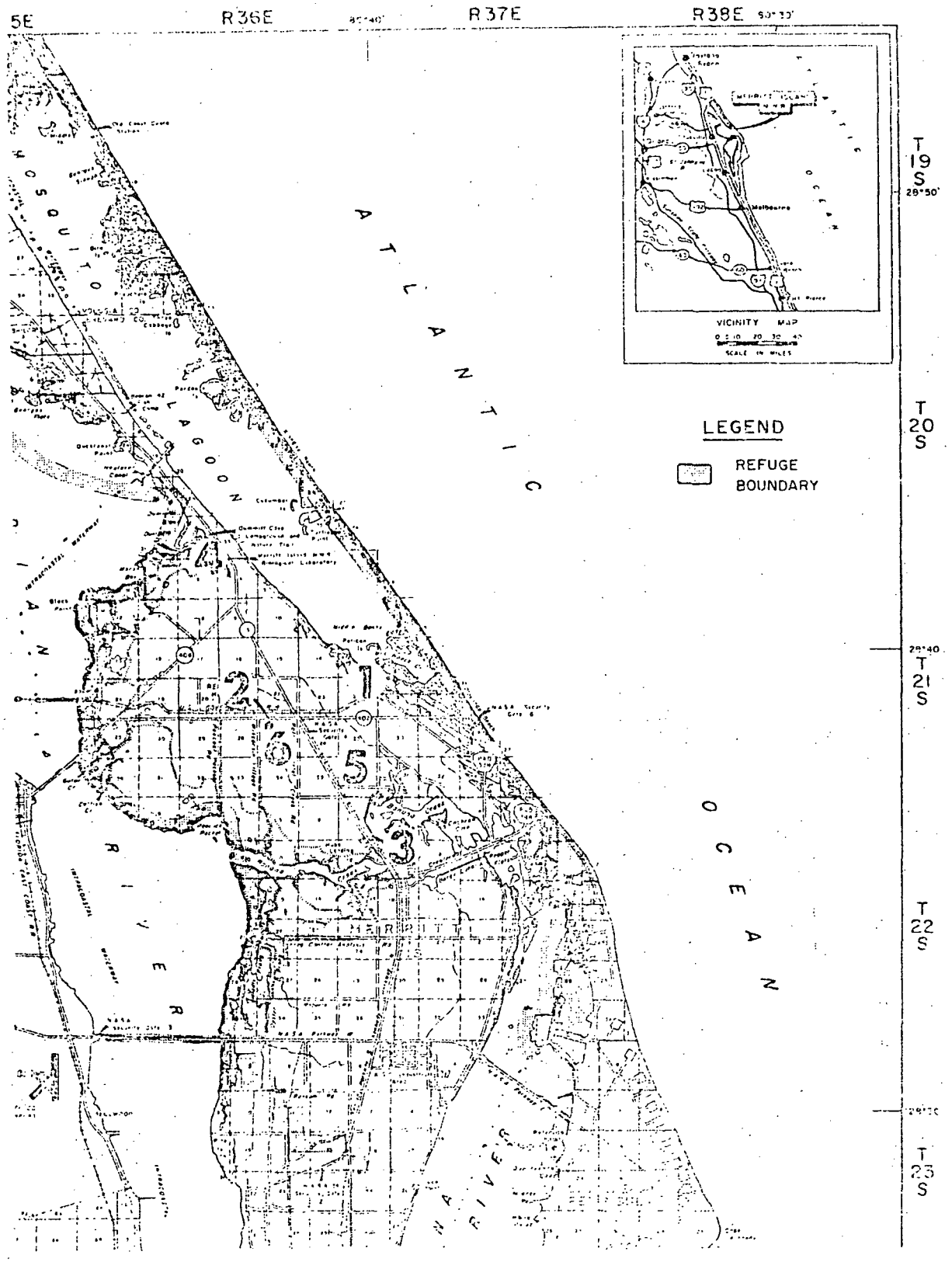
R36E
R37E
R38E
T 19 S
T 20 S
T 21 S
T 22 S
T 23 S
28°50'
28°40'
ATLANTIC OCEAN
INDIAN RIVER
MOSQUITO LAGOON
VICINITY MAP
LEGEND
REFUGE BOUNDARY

Figure 2

Figure 3. Nest size at different ambient temperatures in g of cotton pulled/day. Bars denote mean; vertical lines, the range; black rectangle, the standard deviation. 144 test nights.

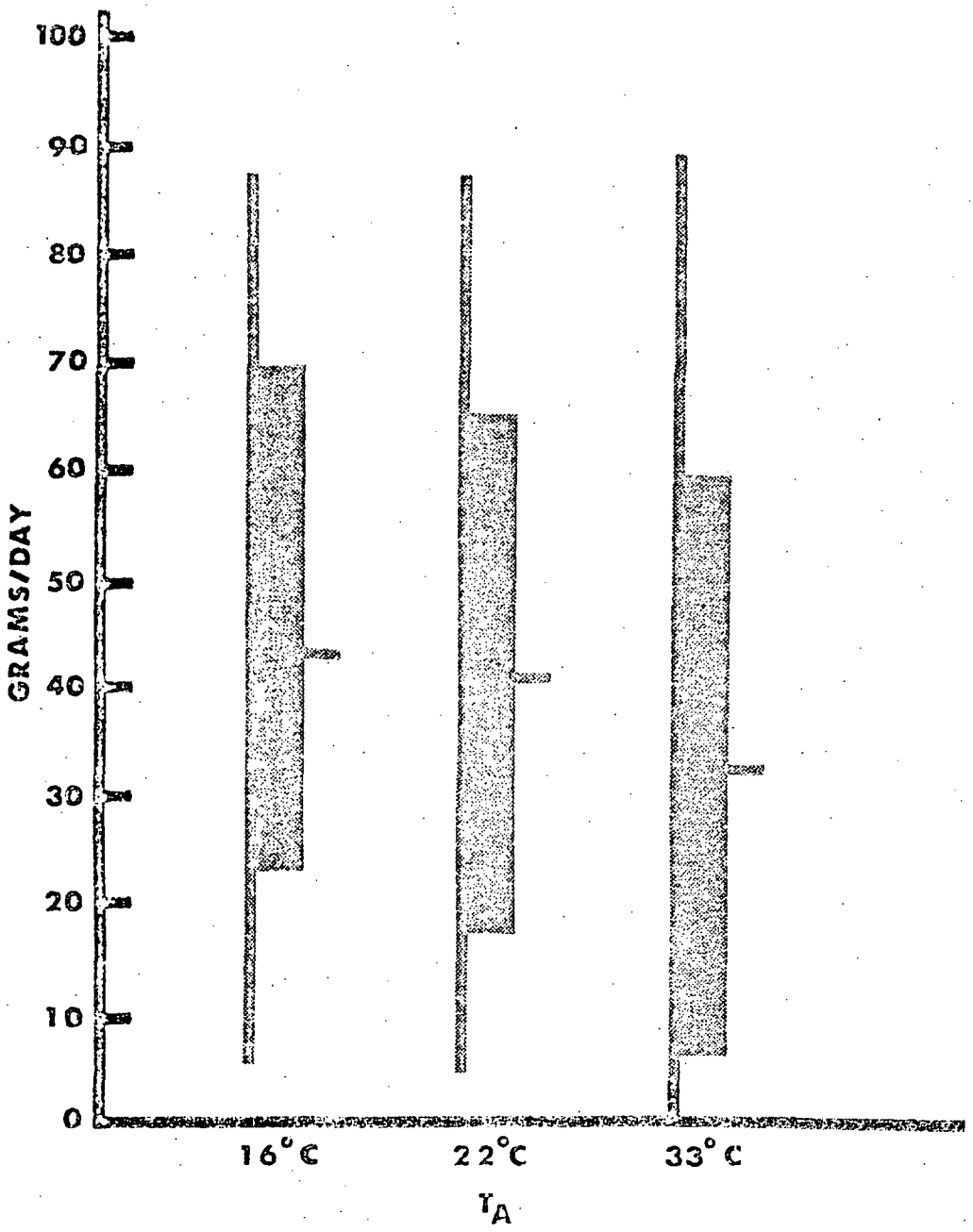

Figure 3

Figure 4. Nest size of O. p. natator captured in three different seasons, all temperatures combined. Symbols as in Fig. 3. 144 test nights.

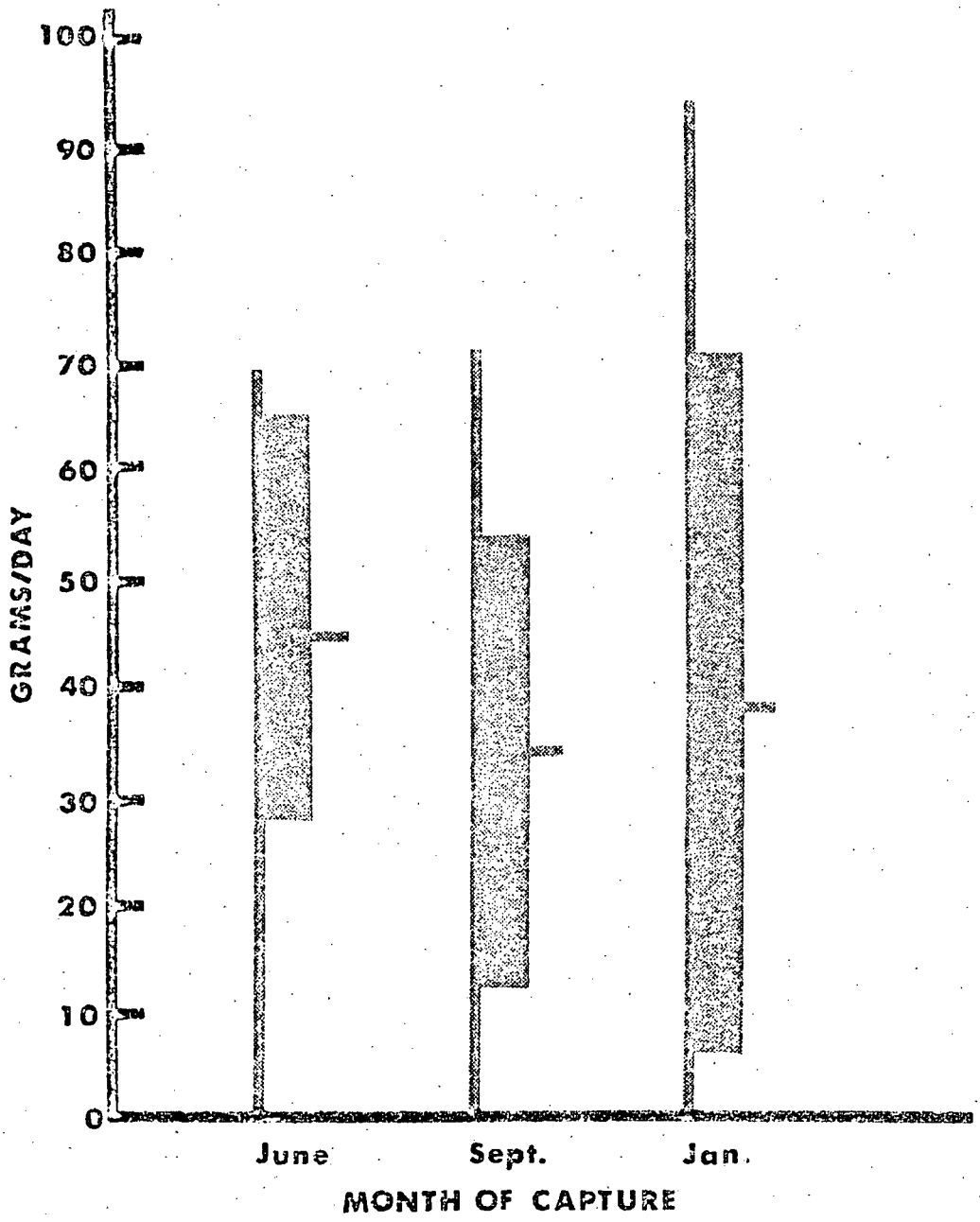
100
90
80
70
60
50
40
30
20
10
0
GRAMS/DAY
June
Sept.
Jan.
MONTH OF CAPTURE

Figure 4

Figure 5. Nest size of O. p. natator captured in three different seasons, at each ambient temperature (T_A), C°. Symbols as in Fig. 3. 144 test nights.

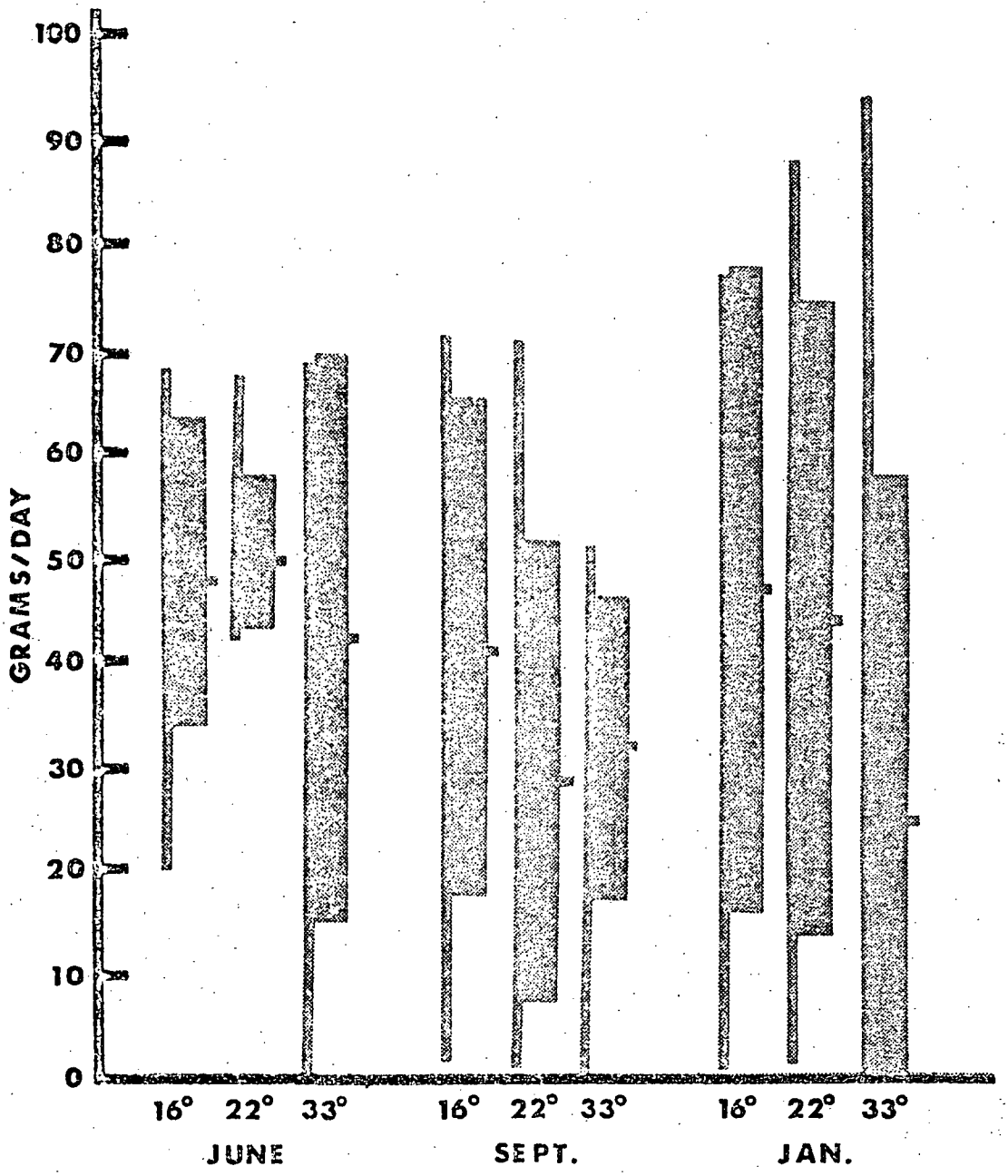
100
90
80
70
60
50
40
30
20
10
0
GRAMS/DAY
16°
22°
33°
16°
22°
33°
16°
22°
33°
JUNE
SEPT.
JAN.

Figure 5

Figure 6. Distribution of nest types at each ambient temperature (T_A) for each of three different seasons. 144 test nights.

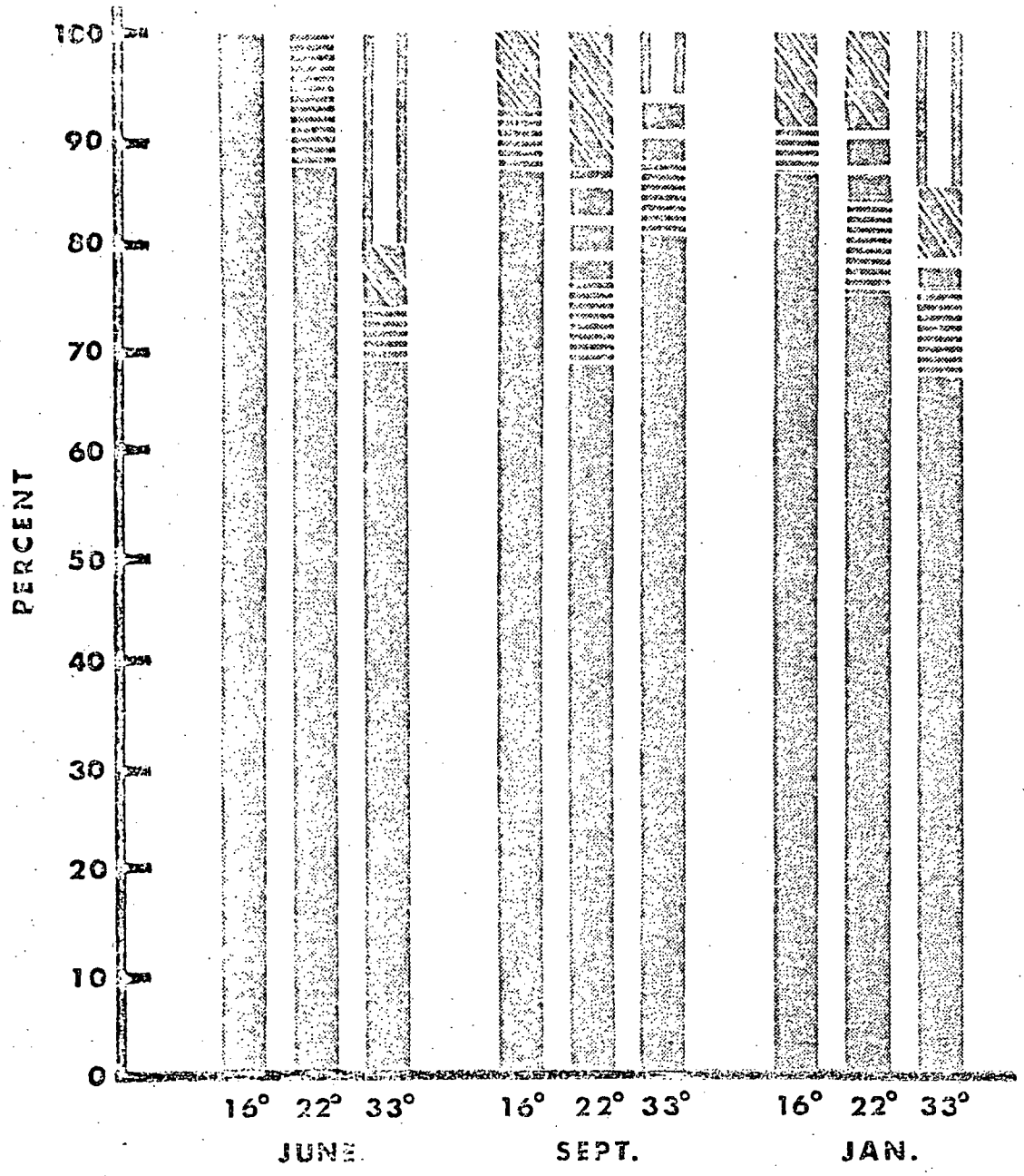
PERCENT
100
90
80
70
60
50
40
30
20
10
0
16° 22° 33°
JUNE
16° 22° 33°
SEPT.
16° 22° 33°
JAN.
NO NEST
PLATFORM
CUP
ROOFED, 2-SIDED
ROOFED, 3-SIDED
ROOFED CUP

Figure 6

Figure 7. Volume in ml of stomach contents of O. p. natator at time of capture. Symbols as in Figure 3. Sample size above column.

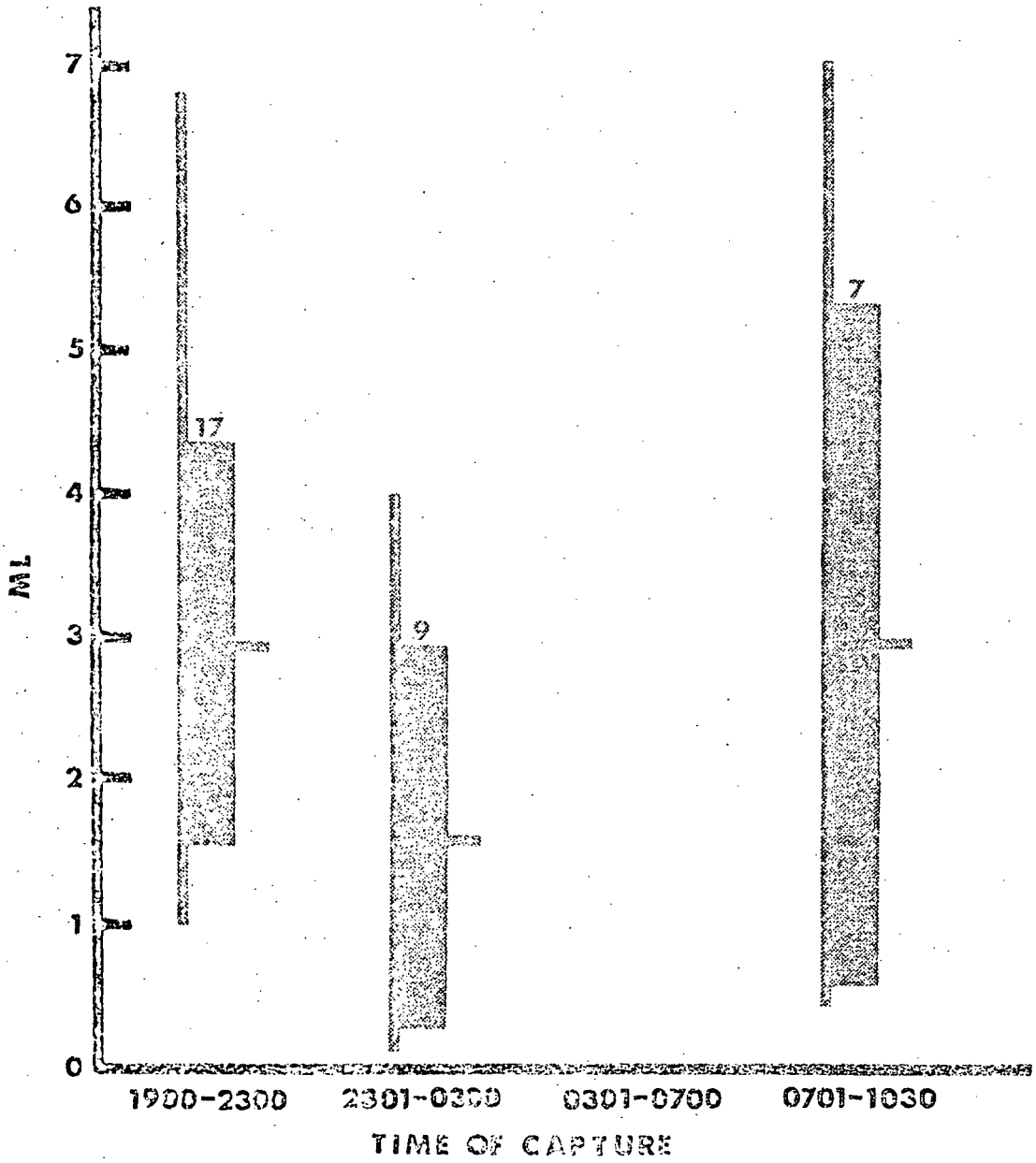
7
6
5
4
3
2
1
0
ML
17
9
7
1900-2300
2301-0300
0301-0700
0701-1030
TIME OF CAPTURE

Figure 7

Table 1. Standard measurements of adult Oryzomys palustris natator from Merritt Island, Brevard County, Florida.

Weights of pregnant ♀♀ are not included.

Measurement	♂♂				♀♀			
	N	$\bar{X}$	Range	SD	N	$\bar{X}$	Range	SD
Weight	22	86.9	53.5--139	25.40	8	60.9	48-- 77.5	10.92
Total Length	21	272.2	233.0--333	25.78	15	247.5	220-271.0	19.46
Tail Length	21	140.5	116.0--162	12.71	14	129.9	113--153.0	12.41
Hind Foot	22	34.0	31.0-- 39	2.08	15	31.5	30-- 33.0	1.12
Ear, crown	21	15.3	11.0-- 17	1.38	16	14.1	8-- 18.0	2.76
Ear, notch	21	16.3	12.0-- 18	1.38	16	15.2	10-- 18.0	2.13

Table 2. Standard measurements of adult Oryzomys palustris natator

Measurement	Merritt Island (N=36)			Gainesville (N=10)		
	$\bar{X}$	Range	SD	$\bar{X}$	Range	SD
Total Length	261.91	222.0--333.0	26.14	276.7	271.0--3--.0	9.66
Tail Length	136.08	115.0--162.0	13.48	142.9	132.0--156.0	8.00
Hind Foot	33.00	30.0-- 39.0	2.16	34.3	32.5-- 37.0	1.50

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